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*Indian Standard*METHOD FOR
DETERMINATION OF APPARENT DENSITY OF
FREE FLOWING POWDERS FOR POWDER
METALLURGICAL PURPOSES*(First Revision)*

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METHOD FOR DETERMINATION OF APPARENT DENSITY OF FREE FLOWING POWDERS FOR POWDER METALLURGICAL PURPOSES (First Revision)

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Indian Standard

METHOD FOR DETERMINATION OF APPARENT DENSITY OF FREE FLOWING POWDERS FOR POWDER METALLURGICAL PURPOSES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 December 1981, after the draft finalized by the Powder Metallurgical Materials and Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1968. Because of the rapid progress in the field of powder metallurgy both at the national and international levels, the present revision has become necessary.

0.3 In the revision of this standard, the following modifications have been made:

- a) The standard has been based on ISO 3923/I-1979 Metallic Powders — Determination of apparent density: Part I Funnel Method;
- b) Reference has been made to the available Indian Standard on sampling of powders for powder metallurgical application;
- c) Clause of test procedure has been made more elaborate; and
- d) An additional clause (clause 7) has been incorporated, giving details to be reported in the Test Report.

0.4 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard relates to the determination of apparent density of free flowing powders for powder metallurgical purposes by the funnel method.

NOTE — Results obtained by this method of test are not comparable with results obtained by other methods, and they do not necessarily represent the fill factor under production conditions.

1.1.1 The method is used for metallic powders that flow freely through a 2.5 mm diameter orifice. It may, however, also be used for powders that flow with difficulty through 2.5 mm diameter orifice, but flow freely through a 5 mm diameter orifice.

1.1.2 The determination of the apparent density of powders that will not flow through a 5 mm diameter orifice is not covered in this standard.

2. PRINCIPLE OF TEST

2.1 The test consists in pouring a test sample of powder through a funnel into a cup of known volume, placed at determined distance above the cup. The mass of the powder in the cup is determined and its apparent density calculated, which is a ratio between the mass and the volume.

3. TEST APPARATUS

3.1 The test apparatus shall comprise a funnel with dimensions as given in Fig. 1. The funnel shall be made of aluminium alloy, brass or stainless steel having a hardness of 140 HV (Min). The surface finish of the material when determined in accordance with IS : 3073-1967*, shall have a roughness not exceeding 0.2 Ra in microns. The funnel shall be fitted with calibrated orifice and its calibration shall be checked periodically in accordance with Appendix A of IS : 4840-1968†.

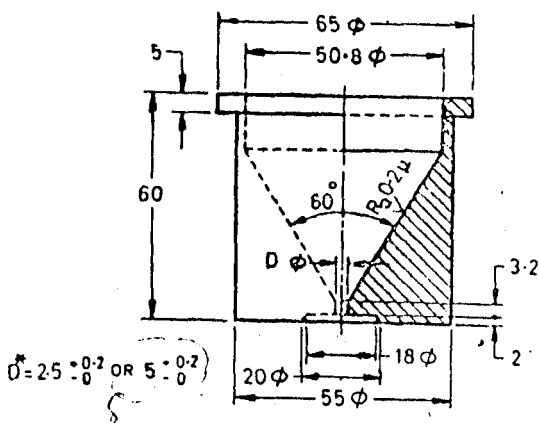
3.2 Cylindrical Cup — having a capacity of 25 ± 0.05 cm³. The inner diameter of the cup shall be about 30 mm.

3.3 Stand — to support the funnel and the cup (see Fig. 2). The arm for the funnel shall be pivoted horizontally. It shall hold the funnel so that the bottom of the funnel orifice is 25 mm above the top of the cup when the apparatus is assembled.

3.4 A balance having a minimum weighing capacity of 100 g. The balance shall be accurate to provide readings within 0.01 g.

*Assessment of surface roughness.

†Method for determination flow rate of powders for powder metallurgical purposes.



All dimensions in millimetres.

FIG. 1 FUNNEL

4. TEST SAMPLE

4.1 Sampling shall be carried out in accordance with IS : 6492-1972†. The quantity of powder used in a single determination shall be approximately 30 to 35 cm³ volume.

5. TEST PROCEDURE

5.1 The apparatus shall be placed on a level vibration-free base and with the funnel concentric with the cup.

5.1.1 In general, the powder should be tested in the as-received condition. In certain instances the powder may be dried. However, if the powder is susceptible to oxidation, the drying should take place in vacuum or in inert gas. If the powder contains volatile substances, it should not be dried.

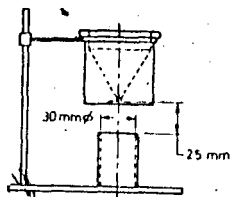


FIG. 2 ASSEMBLED APPARATUS

*These values are mandatory.

†Methods for sampling of powders for powder metallurgical purposes.

5.2 The test sample shall be poured carefully through a 2.5 mm orifice funnel and permitted to run into the cup only until the powder completely fills and overflows the periphery of the cup. The funnel shall then be rotated immediately approximately 90° in a horizontal plane and the powder in the cup levelled off in one operation with a non-magnetic straight edge without compressing it and taking care not to jar or vibrate the cup.

5.3 After the levelling operation, the side of the cup shall be tapped lightly to settle the powder to avoid spilling in transfer. The powder shall then be transferred to the balance and weighed to the nearest 0.05 g.

NOTE — It is recommended to weigh the powder in the cup in which case the balance shall be counterbalanced for the weight of the cup.

5.4 If the powder does not flow through this funnel, a funnel of an orifice of 5 mm shall be used.

5.5 When using a 5 mm orifice funnel the powder still does not flow, it is allowable to attempt to initiate flow by poking once with a 1 mm wire from the top of the funnel. The wire shall not enter the cup.

6. TEST RESULT

6.1 The weight in grams of the powder divided by 25 shall be reported as the apparent density of the powder in grams per cubic centimetre. The arithmetic mean of three determinations shall be reported to the nearest 0.01 g/cm³.

7. REPORT

7.1 The test report shall include the following information:

- a) Reference to this Indian Standard;
- b) All details necessary for identification of the test sample;
- c) The drying procedure, if the powder has been dried;
- d) The nominal diameter of the orifice and the use of a wire, if applied; and
- e) The result obtained.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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